Excel formula and Islamic norms for home financing

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Excel formula Islamic norms and home financing models[1]

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Abstract
This paper is in a series of writings on Islamic home financing. It spells out certain norms Islamic banks must observe in home financing and demonstrates that the conventional model based on an Excel formula does not meet the stated norms. It may well be emphasized that in Islam the question of observing these norms arises before not after the selection of the formula; additional juristic requirements may only follow subsequently. Is it not then queer that many Islamic banks are using the formula to determine the periodic installment payments in their home financing programs? The paper finds for example the popular MMP non-compliant of the stated norms. It presents a new model and argues that the alternative is not only fully observant but is superior to MMP on some other counts as well.

Key words: *Home finance; Excel amortization formula; Compounding; Islamic norms; Justice*

The norms

In home financing Islamic banks take care as they must to ensure two things: First that they avoid erecting structures that leave any room for interest to enter the contract they sign with their clients. Recall in this context that compounding is even more vociferously condemned in the Quran (3: 130-132) than interest.

Second, the ownership of the property passes to the customer in the *same* ratio as the payment made has to the total charge at any point in time. Both these norms follow from Qur'an the word of God and fall under the Islamic notion of justice (*Al-adl*). And justice has an overriding position among the objectives or *maqasid* of Shari'ah. It is an inalienable ingredient of the Islamic notion of *Amanah* the soul of religion. Justice with reference to financial contracts means equality before the law and the scripture forbids withholding from the people "that which rightfully belongs to them" (Qur'an 7:85).

Compounding and Excel

Now, in home financing contracts most of the Islamic banks use across the globe an Excel formula for the determination of uniform periodic installment payments. This paper investigates if the resultant contract leads to meeting the stated norms? The formula is as under.

$$A = P_0 \cdot \frac{r(1+r)^n}{(1+r)^n - 1} \qquad (1)$$

[1]The views expressed in this paper are of the author alone. They need not in any way be attributed to INCEIF the Global university of Islamic finance where he currently works.

Here,

A = Installment amount the customer has to pay per time unit to the bank

P_0 = Bank's contribution (loan) to the purchase price of the house

r = the rate of interest payable on outstanding loan per period

n = number of time units the payment period is divided; be it a week, a month or a year.

To illustrate, let us assume that a customer buys a house worth $100,000. He makes a down payment of $20,000 to the seller from his savings and plans to borrow the remaining amount P_0=$80000 from a bank payable in 10 years in 20 half-yearly installments. To explore possibilities, he first approaches a conventional bank. He is offered the required terms, the rate of interest per year being 8%. He is to mortgage the house with the bank as security. The bank calculates the installment amount inserting the relevant values in the above formula as follows:

$$A = 80000 \frac{0.04(1+0.04)^{20}}{(1+0.04)^{20}-1} = 5887 \text{ approximately} \qquad (2)$$

The half-yearly rate of interest used in the formula is 8/2 = 4% or 0.04 per dollar. Using the value of A from equation (2) we get the total amount P_n the bank will receive in 10 years as under:

Pn=A * n = 5886.54 * 20 = $117731. Bank's profit (interest income) will be:

Pn– P_0 = 117731 – 80000 = $37731 in 10 years i.e. 3773 a year or 4.72% on $80,000.

Notice that A is an exponential function of P_0, r and n. The formula clearly implies compounding of interest income. Interestingly, the fact has explicitly been stated in a 2008 article of Microsoft Excel published on the internet. Still, how compounding comes into the picture is not clear to many; it needs explanation. We know that the standard compound interest formula is

$$Pn = P_0 (1 + r)^n \qquad (3)$$

The formula *capitalizes* interest for each of the n terms to calculate interest for the next or (n + 1) term. The compounding is cumulative if there are no intervening installment payments. Thus, inserting P_0 = $80000, r = 0.08 and n = 10 in the above formula we get:

$$Pn = 80000 (1 + 0.08)^{10} \qquad (4)$$

$$= \$ 172714$$

We may discount back this amount using the formula $P_0 = Pn/ (1 + r)^n$ to arrive back at the initial loan amount $80000.

However, in our illustration half-yearly installments *are* paid. Therefore, we have to find out the rate r_0 to verify compounding. Inserting in the formula $Pn = P_0 (1 + r_0)^n$ the values of Pn = A* n, P_0 and n, we may find r_0 as under.

$$5886.54 * 20 = 80000 (1 + r_0)^{20} \quad (5)$$

Dividing through by 20, we get $5886.54 = 4000 (1 + r_0)^{20}$

$$\ln (5886.54) = \ln (4000) + 20 \ln (1 + r_0)$$
$$3.7699 = 3.60205 + 20 \ln (1 + r_0)$$
$$\ln (1+ r_0) = (3.7699 – 3.60205) /20$$
$$= 0.00839$$
$$(1 + r_0) = 10^{0.00839}$$
$$= 1.01951$$
$$r_0 = 0.01951$$

The compounding rate, $r_0 = 0.01951$ gives us 1.951% half-yearly or 3.9% annually
Verification:

$$Pn = 80000 (1 + 0.01951)^{20} \quad (6)$$
$$= 80000 * 1.47174$$
$$= 117739$$

Return on capital = 117739 – 80000 = 37739

Rate of return per year 4.72% [same as before]

Using the data we now have, we produce Table 1 below to show how compounding enters into the working of the conventional home financing model. The interest charged shown in column E can also be found for each time point n, multiplying (n-1) value of E by r_0 = 0.0 1951 that equation (5) gives. Thus, for n = 1 it would be 80,000 * 0. 01951 = 1560.8 and for n = 2, (80,000 + 1560.8) * 0.01951 = 1591.25 and so on.

Table 1
Compound interest element in conventional model

Half-yearly units	$Pn = P_0 (1+ r_0) n$	Interest Charged	Compound Element 1 E * r i.e. E * 0.04
n	Dn	E	F
0	80000		
1	81561	1561	62
2	83152	1591	64
3	84774	1622	65
4	86428	1654	66
5	88115	1687	67
6	89834	1719	69
7	91586	1752	70

Table 2
Installments R on C&R of C

Half-yearly Installments $	Outstanding Balance = P_{n-1} - A + H	Return on capital R on C P_0 * 0.04	Return of capital R of C A - H	Compounding Element 2 = H * r = 0.04
A	Pn	H	K	M
	80000			
5886.54	77313	3200	2687	128
5886.54	74520	3093	2794	124
5886.54	71614	2981	2906	119
5886.54	68593	2865	3022	115
5886.54	65450	2744	3143	110
5886.54	62182	2618	3269	105
5886.54	58782	2487	3399	99

8	93373	1787	71		5886.54	55247	2351	3535	94
9	95195	1822	73		5886.54	51571	2210	3677	88
10	97052	1857	74		5886.54	47748	2063	3824	83
11	98946	1894	76		5886.54	43771	1910	3977	76
12	100876	1930	77		5886.54	39636	1751	4136	70
13	102844	1968	79		5886.54	35335	1585	4301	63
14	104851	2007	80		5886.54	30862	1413	4473	57
15	106896	2045	82		5886.54	26209	1234	4652	49
16	108982	2086	83		5886.54	21370	1048	4838	42
17	111108	2126	85		5886.54	16338	855	5032	34
18	113280	2172	87		5886.54	11105	654	5233	26
19	115486	2206	88		5886.54	5662	444	5442	18
20	**117739**	2253	90		5886.54	1	227	5660	9
Total		**37733**	**1510**		**117730.8**	**37733**		**79998**	**1509**

Compounding then is precisely the capitalization of interest for charging *interest on interest.* Column F isolates the compounding element in interest, for $F = En - En_{-1}$. Notice that column Dn records cumulative amounts. Thus, the value for n = 20 in that column gives us the aggregated amount ($117739).

Table 1 shows that the Microsoft Excel formula for installment determination involves compounding of interest in home financing. Column Dn is obtained by using equation (4) for each n time point. Column E records the excess in each cell over the preceding cell value in column Dn. Compounding element in F column is obtained by multiplying the amount in column E by the half-yearly rate of interest r = 0.04. Notice that in Table 2 we have:

$$Pn = Pn_{-1} - A + H \qquad (7)$$

Thus, each time we deduct installment payment from the preceding value or Pn-1 but at the same time we add back the return on capital (H) to arrive at current balance (Pn). In other words, we regularly leave the return on capital embedded in the outstanding balance. We know that H = Pn-1* r. Putting this value of H in (7) we get:

$$Pn = Pn_{-1} - A + Pn_{-1} * r.$$

Simplifying we get

$$Pn = Pn_{-1} (1 + r)^n - A \qquad (8)$$

Compounding is so vivid in the formula: interest is charged on interest all along down the line.We have once more isolated the compounding as shown in column M. Thus, two demonstrations are presented on compounding giving identical results – the sum of column F equals the sum of column M. Compounding yields a return of almost 0.19% a year on $80,000. The impact of compounding on the customer is clear. Table 1

does not provide the details of how the process of repayment goes with the customer but Table 2 clarifies the process. Interestingly, one may find return of capital in column K growing over time on the compounding principle $(1+r)^n$ in conformity with evidence provided. Let us now take up the issue of ownership transfer (rate) to the customer in conventional financing.

Ownership transfer to the customer

Justice demands that the rates of payment and transfer of ownership to the customer must be identical. However, under interest financing the transfer rate is all through lower than of the payment completed. Out of the uniform installment the compounding process compulsively allocates more towards the payment of interest than return of capital. Thus, the latter amount becomes smaller than the payment rate. Figure 1 provides a visual evidence of this crucial fact violating the Islamic norm. The evidence follows from the data in Table 3.

Table 3

Home ownership transfer to the customer in conventional finance

Payment Number	Cumulative Payments n * A	Payment ratio % L/P_0	Outstanding Balance = From Table 2	Ownership transfer (1 – N/80000)100 %
n	L	M	N	H
1	5886.54	5	77314	3.35
2	11773.08	10	74520	6.85
3	17659.62	15	71614	10.48
4	23546.16	20	68593	14.26
5	29432.70	25	65450	18.19
6	35319.24	30	62182	22.27
7	41205.78	35	58782	26.52
8	47092.32	40	55247	30.94
9	52978.46	45	51571	35.54
10	58865.40	50	47748	40.32
11	64751.94	55	43771	45.29
12	70638.48	60	39636	50.46
13	76525.02	65	35335	55.83
14	82411.56	70	30862	61.42
15	88298.10	75	26209	67.24
16	94184.64	80	21370	73.28
17	100071.18	85	16338	79.58
18	105957.72	90	11105	86.12
19	111844.26	95	5662	92.92
20	117730.80	100	2	100
Total			**117730.8**	**37733**

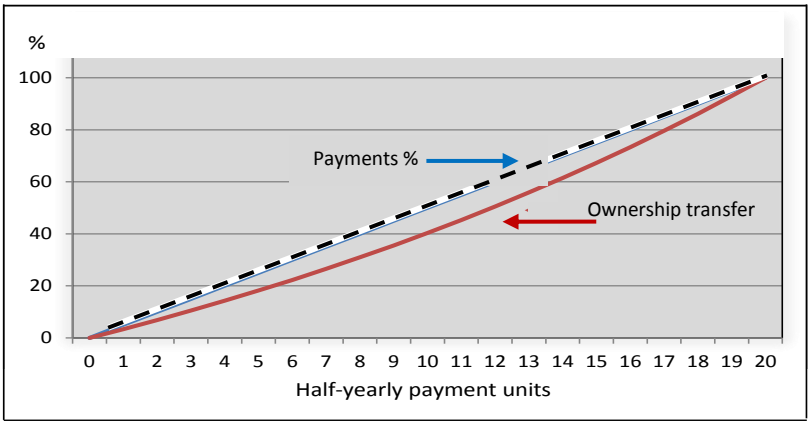

Figure 1: Conventional home financing transfers ownership to the customer at a slower than the payments rate

The above discussion reinforces the assertion that Excel formula for installment determination is not free of compounding. Microsoft has mentioned as said earlier the fact in its publications. In addition to compounding,we have candidly established that if the formula is used the ownership of the house would unavoidably pass to the customer all along at a slower rate than at which he makes the payment. Thus, the formula meets neither of the two basic Islamic norms we started with.

We have already shown elsewhere (Hasan, 2011) that if the periodic installment payments in an Islamic home financing program like the MMP are determined the same way as in the conventional model using the Excel formula; the consequences must be identical if the annual rental equals interest rate i.e. 8% a year for our illustration. The MMP would defy the stated Islamic norms identically. We produce comparative facts in Table 4 to make the argument of the paper self-contained. For details of arriving at the Table 4 below the reader may find data in our earlier writings on the subject (See for example Hasan, 2010).

Table 4: Excel formula gives identical results in the conventional and the MMP models

N	A		B	C	D	E	F	G	H
	Balance outstanding		Return of capital		Compound Rate	Return on capital		Installment	
	CON	**MMP**	**CON**	**MMP**		**CON**	**MMP**	**CON**	**MMP**
1	80000	80000	2687	2687	1.04	3200	3200	5887	5887
2.	77313	77313	2794	2794	1.04	3093	3093	5887	5887
--	--	--	--	--	--	--	--	--	--
19.	11091	11091	5443	5443	1.04	444	444	5887	5887
20.	5647	5647	5661	5661	1.04	226	226	5887	5887
Total	**94475**	**94475**	**80000**	**80000**		**37740**	**37740**	**117740**	**117740**

ZDBM – An alternative

The customer in our illustration subsequently approaches an Islamic bank to find details for obtaining the remaining $80,000 payable in 10 years spread over 20 half-yearly installments sans interest. The bank agreeing to meet his requirements makes the offer as follows. "The bank shall provide the remaining $80,000 to acquire a *proprietary share* in the house, you acting as our agent. For getting back our investment of $80,000 in 20 equal installments spread over ten years, you will pay $4000 each six-months. In addition, we shall put a yearly mark-up of 8% (4% half-yearly) on our ownership share in the house any point in time i.e. the mark-up amount will be calculated on the diminishing balance (value) of our share in the property.That would help reduce your liability to the bank over time proportionately. The registration of the house in the court will be in your name but you will have to sign simultaneously a mortgage deed pledging the property with the bank as security until installments are all cleared". The client agrees to the terms offered[2]. The bank provides him a Table given below detailing his half-yearly installment payments combining the two components return of capital and the return on capital. This is a simple table; the arrows illustrating how the return on capital is calculated. The de facto average rate of return the client would pay to the bank is [$33600/80000] /10 = 4.2% per annum.

Table 5: ZDBM in operation

Installment # n A	Return of Capital B	Outstanding Balance C	Return on Capital 4% D	Installment payment E = B + D
0	--	$80000	--	--
1	$4000	$76000	$3200	$7200
2	$4000	$72000	$3040	$7040
3	$4000	$68000	$2880	$6880
4	$4000	$64000	$2720	$6720
5	$4000	$60000	$2560	$6560
6	$4000	$56000	$2400	$6400
7	$4000	$52000	$2240	$6240
8	$4000	$48000	$2080	$6080
9	$4000	$44000	$1920	$5920
10	$4000	$40000	$1760	$5760
11	$4000	$36000	$1600	$5600
12	$4000	$32000	$1440	$5440
13	$4000	$28000	$1280	$5280

[2]We have kept the rate of return in the three cases unchanged at 8% a year for purposes of comparing the consequences.

14	$4000	$24000	$1120	$5120
15	$4000	$20000	$960	$4960
16	$4000	$16000	$800	$4800
17	$4000	$12000	$640	$4640
18	$4000	$8000	$480	$4480
19	$4000	$4000	$320	$4320
20	$4000	$0	$160	$4160
Total	**$80000**	**$8400000**	**$33600**	**$113600**

Shorn of the finer legal and regulatory details, the ZDBM structure the Table contains would require three mutually exclusive and independent contracts for consecutive execution.

1. A sale contract involving the customer, the bank and the seller giving co-ownership of the house to the first two in their initial payments ratio of 20:80. The customer will work as their agent, the bank arranging legal authority for him.
2. A second contract whereby the bank sells his share in the property to the customer with an agreed 8% mark-up over their $80000 investment.
3. A third contract whereby the customer mortgages the house with the bank until the acts installments have all been paid in full.

Figure 2 shows the contractual relationships of the three parties. The seller will be out of the picture after the first contract. Only the client and the bank will stay together for 10 years. In essence, ZDBM is a murabahah-mortgage combination.

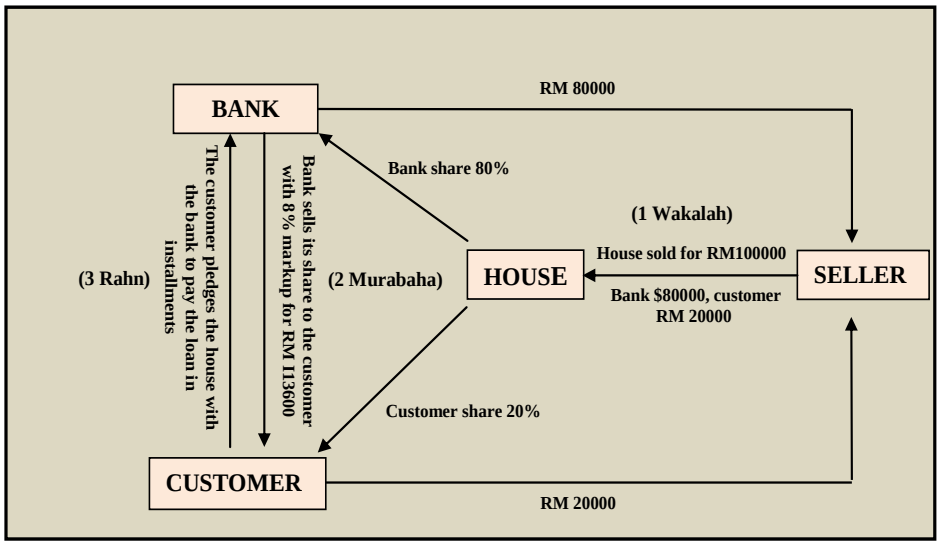

Figure 2: Contractual structure of the ZDBM

Comparison of models

Let us compare the main features of the ZDBM with the Musharakah Mutanaqisah Partnership (MMP) program. We found in Table 4 the results of the two models – conventional and the MMP identical because both models use the same Excel formula for fixing the installment payment. Leaving aside the compounding of interest issue, we find some other merits too in the ZDBM. The comparison is facilitated by the following Table. 6. Take note of the following facts.

Table 6: ZDBM VS. MMP: Comparative data

n	Outstanding balance		Return of Capital (R of C)		Return on Capital (R on C)		Installments	
	ZDBM	MMP	ZDBM	MMP	ZDBM	MMP	ZDBM	MMP
	A	**B**	**C**	**D**	**E**	**F**	**H**	**K**
1	80000	80000	4000	2687	3200	3200	7200	5887
2	76000	77313	4000	2794	3040	3093	7040	5887
3	72000	74519	4000	2906	2880	2981	6880	5887
4	68000	71614	4000	3022	2720	2865	6720	5887
5	64000	68592	4000	3143	2560	2744	6560	5887
6	60000	65449	4000	3269	2400	2618	6400	5887
7	56000	62180	4000	3399	2240	2487	6240	5887
8	52000	58781	4000	3535	2080	2351	6080	5887
9	48000	55246	4000	3677	1920	2210	5920	5887
10	44000	51569	4000	3824	1780	2063	5780	5887
11	40000	47745	4000	3977	1600	1910	5600	5887
12	36000	43768	4000	4136	1440	1751	5440	5887
13	32000	39633	4000	4301	1280	1585	5280	5887
14	28000	35331	4000	4473	1120	1413	5I20	5887
15	24000	30858	4000	4652	960	1234	4960	5887
16	20000	26206	4000	4838	800	1048	4800	5887
17	16000	21368	4000	5032	640	855	4640	5887
18	12000	16336	4000	5233	480	653	4480	5887
19	8000	11103	4000	5442	320	444	4320	5887
20	4000	5660	4000	5661	160	226	4160	5887
Total	**840000**	**943270**	**80000**	**80001**	**33600**	**37731**	**113600**	**117740**

- ZDBM turns out to be cheaper for the customer due to a faster repayment of capital plan. For example, in our illustration the customer gains $4131 - the difference between the return on capital columns' total in Table 6.
- Significantly, the customer does not gain at the cost of the banker. Notice that the sum of outstanding balances, which we take as proxy for funding deposits, reduces in the ZDBM proportionate to the reduction in the return on capital volume. See the following equation. Figures are from the column totals in the Table.

$$\frac{\text{Models } ZDBM}{MMP} = \frac{\text{Funding Deposis}}{840000 \over 943270} = \frac{\text{Return on Capital}}{33600 \over 37731} = 0.891$$

Thus, the margin on funding deposits remains the same in both cases i.e. 4%. ZDBM is a win-win model for both the parties: The cost of the house is reduced for the client. Islamic banks get an edge over their conventional rivals while their profit margin remains unchanged.

- The ZDBM is more efficient; it absorbs fewer resources – funding deposits are smaller. For the same reason, the model must also increase the liquidity levels in the system.

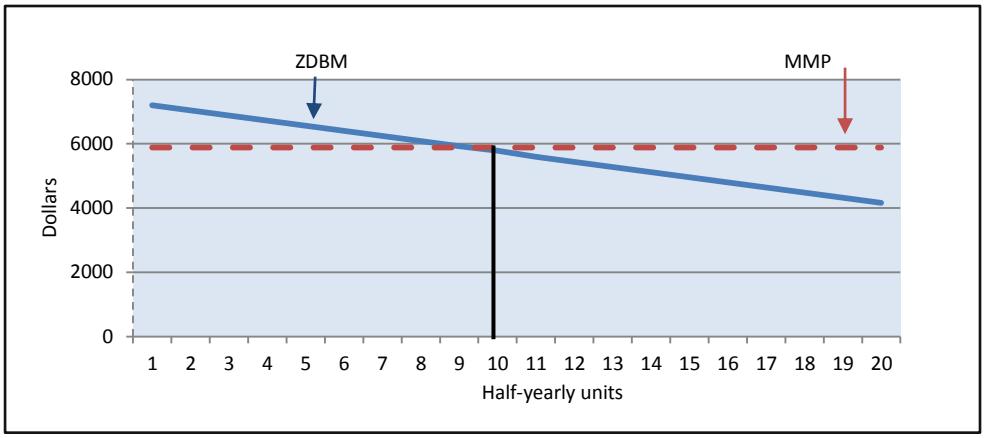

Figure 3: Installment Payments Compared

The ownership of property passes faster to the customer. Researches show that constant amortization programs as in the ZDBM are more equitable than any other scheme in operation. (Chambers et al 2007). In our illustration, half way down the time scale 50% ownership passes to the customer as compared to 40% under the MMP. (See Figure 3). Thus, the margin on funding deposits remains the same in both cases i.e. 4%. ZDBM is a win-win model for both the parties: The cost of the house is reduced for the client. Islamic banks get an edge over their conventional rivals without losing on the profitability front.

- It follows that the ZDBM is more efficient; it absorbs fewer resources – funding deposits are smaller. For the same reason, the model must also increase the liquidity levels in the system.
- The ownership of property passes faster to the customer. The reason is that the Excel formula allocates in the beginning more of installment payments to return on capital making the return of capital which remains uniform in the ZDBM. as figure 4 candidly shows. In the case of default, ZDBM is more equitable to the parties. Suppose in our

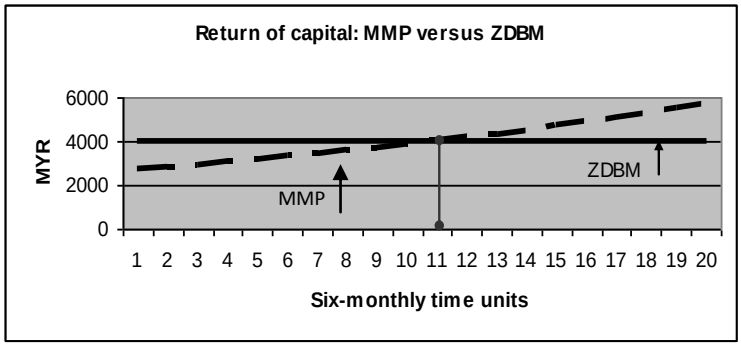

Figure 4: Return of capital **c**ompared

illustration default takes place half-way i.e. after 10 instalments have been paid in each case (See Table 6). Under the ZDBM, the buyer's liability reduces proportionately to 50% while under the MMP he will still have to pay almost 60% of the debt, $7744 more to be exact.

- The condition of the customer in default may not be comfortable under the MMP for another reason. A few banks have insisted that not only the balance of capital remaining outstanding but also the return on it for the remaining period must be treated as unpaid liability of the client to meet the banks' commitment to their depositors.
- Home financing usually being long-term, there may arise and have arisen in the MMP disputes on the revision of rental, the value of the property and the amount of liability remaining unpaid once default takes place. In the ZDBM matters are much clearer. The return on capital – the operation of the mark-up stops at once in case of default. The house will remain under charge for any outstanding balance on capital account alone.
- The MMP also requires the creation of three transactions: (i) creation of a joint ownership in property. (ii) the financier leases his share in the house to the customer on rent and (iii) the customer undertakes to purchase different units of the financier's share until the ownership is completely transferred to the former. Taken singly, the jurists regard the three transactions valid if certain conditions are fulfilled. However, it is strongly doubted if their combination in a single contract can be allowed.
- Scholars are divided on the issue if the undertaking of the customer to buy-back the financier's share in the property would be enforceable in a court of law because of the absence of consideration, if not for the lack of free will.

- The shares are not divided in uniform units and the mechanism of determining the fair value of each is never in place. What is done is to treat the rent portion accruing to the client as both the price and the market value of the share – the client never sees a penny of the rent he earns. He has no option but to agree to this arrangement.
- Some scholars provide implicit support to the MMP structure on the plea that interest rate serves as a benchmark. The statement is misleading. A benchmark is the reference point to measure the efficacy the actual value. If it is used in place of the value, it no longer remains a benchmark. Sea level is used as the benchmark for heights of the existing or future structures from the geographic viewpoint, not to put structures at that level.

Finally, uniformity of installment payments is claimed as the main advantage of the MMP program. The customer is not to readjust every time his budget as the upfront payment is the same. This payment not only remains uniform but is lower than in ZDBM for the early periods thus making easier for the young people to go in for housing even when they are at the lower rungs of the income ladder. But even if one concedes the advantage for a moment, can meeting the Islamic imperatives be sacrificed for that gain? When one may want to buy a house does not always or entirely dependent on age. It is well to note that periodic payments in the ZDBM though not constant, are regular in the sense of falling at a constant rate. The payments are of course on the higher side to start with but they become increasingly lower half-way through. Figure 4 above vividly brings out these facts. Which side of the divider one would see the advantage cannot be determined a priori; individuals' circumstances would matter. Furthermore, the two-income households becoming increasingly common tend to pale the life-cycle theory into insignificance.

Conclusion

Most Islamic banks have been shifting to *musharakah-mutanaqisah* program or the MMP model for home financing. We have shown that Islamic banks using the Excel formula in the MMP models have results identical with those of our conventional model illustration (See also Hasan 2011, 2012). Our main concern here was to show that there is no juristic ground the banks using the Excel formula to stand on. The use palpably violates Islamic requirements. And, to us the debate on the Islamic efficacy of the MMP, or any other model

for that matter, starts before selecting the formula for use not thereafter. We have provided an alternative model for replacing the commonly used MMP. The new model is not only free of blemishes the MMP has, it is cheaper for the customer without any reduction in the margin of profit for the banks as it absorbs proportionately less funds. It is also much better on some related issues like costs, efficiency, liquidity, and equity compared to models Islamic banks presently use for home financing. We feel that the life cycle concerns are trivial in the face of these gains. The fixity of upfront payments cannot condone Shari'ah non-compliance. In any case, the payments in the ZDBM too diminish at a *constant* amount. The readers may find some of the references helpful for further clarification of the issues.

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